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EXAMINER	
GUILL, RUSSELL L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/791,218	ZHENG ET AL.	
	Examiner	Art Unit	
	Russ Guill	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 3/2/2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-71 is/are pending in the application.

4a) Of the above claim(s) 50-51,52,57-59,60-67 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-49,53-56 and 68-71 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 02 March 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date See Continuation Sheet.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :8/13/2004,11/16/2004,1/31/2005,8/1/2005.

DETAILED ACTION

1. This Office Action is a first action on the merits for application 10/791218, filed March 2, 2004. The application claims priority to provisional application 60451825, filed March 3, 2003. Claims 1 - 44, 45 – 49, 53, 54 - 56, 68 – 70, 71 have been examined. Claims 1 - 44, 45 – 49, 53, 54 - 56, 68 – 70, 71 have been rejected.

Election/Restriction

2. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1 - 44, 45 – 49, 53, 54 - 56, 68 – 70, 71 drawn to a method and apparatus for predicting a value of a property of processed material, and structural analysis of a manufactured part, classified in class 703, subclass 2.

II. Claims 50 – 51, drawn to a method for designing a part, classified in class 703, subclass 1.

III. Claim 52, drawn to a method for designing a manufacturing process, classified in class 700, subclass 97.

IV. Claims 57 - 59, drawn to a method for simulating fluid flow within a mold cavity, classified in class 703, subclass 6.

V. Claims 60 - 67, drawn to a method for predicting a morphological characteristic of structures within a manufactured part, classified in class 703, subclass 9.

3. Inventions I, II, III, IV and V are unrelated. Inventions are unrelated if it can be shown that they are not disclosed as capable of use together and they have different designs, modes of operation, and effects (MPEP § 802.01 and § 806.06). In the instant case, the different inventions are a method and apparatus for predicting a value of a property of processed material, and structural analysis of a manufactured part, a method for designing a part, a method for designing a manufacturing process, a method for simulating fluid flow within a mold cavity, and a method for predicting a morphological characteristic of structures within a manufactured part; the different inventions are unconnected in design, operation and effect. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions have acquired a separate status in the art in view of their different classification, restriction for examination purposes as indicated is proper.

4. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions require a different field of search (see MPEP § 808.02), restriction for examination purposes as indicated is proper.

5. During a telephone conversation with William Haulbrook on February 1, 2008, a provisional election was made without traverse to prosecute the invention of Class I,

claims 1 - 44, 45 – 49, 53, 54 - 56, 68 – 70, 71. Affirmation of this election must be made by applicant in replying to this Office action. Claims 50 – 51, 52, 57 – 59, 60 - 67 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Information Disclosure Statement

6. The information disclosure statement (IDS) filed August 13, 2004 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the entries C23 and C30 do not provide an author, title and date. Entries C49 and C59 – C97 were not in the application files. The IDS has been placed in the application file, but the information referred to therein has not been considered as to the merits. The missing date information would prevent publication at the time of issue.

7. The information disclosure statement (IDS) filed November 16, 2004 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the entries C98, C104 and C106 were not in the application files. The IDS has been placed in the application file, but the information referred to therein has not been considered as to the merits.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

a. Claim 26 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

i. Regarding claim 26, the claim recites, "FENE-P". FENE-P appears to be an acronym, but is not defined in the claim. The meaning should be defined with FENE-P in parentheses.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claim 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng (R. Zheng and P. Kennedy, "Numerical Simulation of Crystallization in Injection Molding", art provided by the Applicant on the Information Disclosure Statement dated January 31, 2005, item number C118) in view of Yu (U.S. Patent Number 6,096,088).

a. The art of Yu is directed to design of articles to be manufactured by injection molding, preferably from molten plastic materials (*column 1, lines 5 – 10*).

b. The art of Zheng is directed to numerical simulation of crystallization in injection molding of polymers (*title, abstract*).

c. The art of Zheng and the art of Yu are analogous art at least because they both pertain to injection molding of plastic articles.

d. The motivation to use the art of Yu with the art of Zheng would have been the benefit recited in Yu that economic benefit is derived from simulation because problems can be predicted and solutions tested prior to the actual creation of a mold (*column 1, lines 25 – 30*).

e. Regarding **claim 1**:

f. Zheng appears to teach:

g. (c) obtaining a morphological characterization of the material using the characterization of the flow of the material (*sixth page, section "Numerical Method", second paragraph, "The generalized Newtonian kinematics obtained from the solution of the HEle-Shaw equation are then used to calculate the viscoelastic stresses, orientation and crystallinity . . ."*);

h. (d) predicting a value of a property of the material using the morphological characterization (*seventh page, section "Results and Discussion", first paragraph, "The predicted crystallinity can be further used in the viscosity calculation"; viscosity is a property of*

a material predicted using the morphological characteristic, crystallinity; and sixth page, Pressure-Volume-Temperature (PVT) Behavior, density and specific volume are determined using crystallinity).

i. Zheng does not specifically teach:

j. (a) providing a process description comprising at least one governing equation;

k. (b) obtaining a characterization of a flow of a material using the process description;

l. Yu appears to teach:

m. (a) providing a process description comprising at least one governing equation (*column 1, lines 47 – 60; and column 13, lines 12 – 45; this limitation appears to be common knowledge in the art*);

n. (b) obtaining a characterization of a flow of a material using the process description (*column 1, lines 47 – 60; and column 13, lines 12 – 45; this limitation appears to be common knowledge in the art*);

o. Obviousness must be determined in light of the knowledge of the ordinary artisan. The following references teach knowledge of the ordinary artisan:

i. Antonios K. Doufas et al., "A continuum model for flow-induced crystallization of polymer melts", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004; teaches simulation of flow-induced crystallization of polymer melts (*Abstract*) using a two phase model with crystallization kinetics (*Abstract, and page 86, last paragraph*), and calculating material properties from morphology (*pages 94 – 95, section C. Calculation of material and rheo-optical properties*).

ii. X. Guo et al., "Crystallinity and Microstructure in Injection Moldings of Isotactic Polypropylenes. Part 1: A New Approach to

Modeling and Model Parameters", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42; teaches a simulation of injection molding process of semi-crystalline polymers to predict the development of crystallinity and microstructure (*page 2113, section Conclusions*).

p. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Yu with the art of Zheng to produce the claimed invention.

q. Regarding **claim 2**:

r. Zheng does not specifically teach:

s. the process description comprises a representation of an injection molding process.

t. Yu appears to teach:

u. the process description comprises a representation of an injection molding process (*column 1, lines 47 - 60; and column 13, lines 12 - 45; this limitation appears to be common knowledge in the art*).

v. Regarding **claim 4**:

w. Zheng appears to teach:

x. the at least one governing equation comprises conservation of mass, conservation of momentum, and conservation of energy equations (*first page, section "Governing Equations", first sentence, ". . . the mass, momentum and energy conservation equations . . ."; the limitation appears to be common knowledge in the art*).

y. Regarding **claim 16**:

z. Zheng appears to teach:

aa. the morphological characterization comprises a measure of crystallinity (*sixth page, section "Numerical Method", second paragraph, "The generalized Newtonian kinematics obtained from the solution of the HEle-Shaw equation are then used to calculate the viscoelastic stresses, orientation and crystallinity from equations (10), (16) and (22) through (27)"; the crystallinity in equation (10) is a relative crystallinity as defined on the second page, first paragraph, " . . . α the relative crystallinity . . ."*);

bb. Regarding **claim 17**:

cc. Zheng appears to teach:

dd. the measure of crystallinity is a measure of relative crystallinity (*sixth page, section "Numerical Method", second paragraph, "The generalized Newtonian kinematics obtained from the solution of the HEle-Shaw equation are then used to calculate the viscoelastic stresses, orientation and crystallinity from equations (10), (16) and (22) through (27)"; the crystallinity in equation (10) is a relative crystallinity as defined on the second page, first paragraph, " . . . α the relative crystallinity . . ."*);

ee. Regarding **claim 18**:

ff. Zheng appears to teach:

gg. step (c) comprises obtaining the morphological characterization using a description of crystallization kinetics of the material (*fifth page, section "Crystallization Kinetics", and first page, Abstract*).

hh. Regarding **claim 19**:

ii. Zheng appears to teach:

jj. the description of crystallization kinetics of the material comprises a dimensionality exponent (*fifth page, section "Crystallization Kinetics", "m is the Avrami exponent", and "Theoretically the Avrami exponent is related to . . . the dimensionality of the crystal growth"*).

kk. Regarding **claim 22**:

ll. Zheng appears to teach:

mm. obtaining the morphological characterization using a two-phase description of the material (*first page, abstract; an amorphous phase model and a crystalline phase model are used, while the crystallization kinetics model depends upon flow induced stresses*).

nn. Regarding **claim 23**:

oo. Zheng appears to teach:

pp. the two-phase description comprises at least one of a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model (*first page, abstract; an amorphous phase model and a crystalline phase model are used, while the crystallization kinetics model depends upon flow induced stresses*).

qq. Regarding **claim 24**:

rr. Zheng appears to teach:

ss. the two-phase description comprises a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model (*first page, abstract; an amorphous phase model and a crystalline phase model are used, while the crystallization kinetics model depends upon flow induced stresses; and third page, last paragraph, section "Semicrystalline phase"*).

tt. Regarding **claim 25**:

uu. Zheng appears to teach:

vv. the two-phase description comprises a viscoelastic constitutive equation that describes an amorphous phase (*third page, equation 10, Phan-Thien Tanner model*).

ww. Regarding **claim 28**:

xx. Zheng appears to teach:

yy. the viscoelastic constitutive equation comprises at least one of a Giesekus model and a Phan-Thien Tanner model (*third page, equation 10, Phan-Thien Tanner model*).

zz. Regarding **claim 29**:

aaa. Zheng appears to teach:

bbb. the two-phase constitutive description comprises a rigid dumbbell model that describes a semi-crystalline phase (*third page, section "Semi-crystalline phase", first paragraph*).

ccc. Regarding **claim 36**:

ddd. Zheng does not specifically teach:

eee. using a dual domain solution method

fff. Yu appears to teach

ggg. using a dual domain solution method (*column 3, lines 17 - 35; please note that the specification recites that Yu teaches a dual domain solution method*).

hhh. Regarding **claim 38**:

iii. Zheng appears to teach:

jjj. step (b) is performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a) (*sixth page, section "Numerical Method", first and second paragraphs*).

kkk. Regarding **claim 39**:

lll. Zheng appears to teach:

mmm. steps (b) and (c) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a) (*sixth page, section "Numerical Method"*).

nnn. Regarding **claim 40**:

ooo. Zheng appears to teach:

ppp. steps (b), (c), and (d) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a) (*sixth page, section "Numerical Method"*).

qqq. Regarding **claim 41**:

rrr. Zheng appears to teach:

sss. step (c) comprises performing one or more crystallization experiments to determine one or more parameters used to obtain the morphological characterization (*fifth page, section "Crystallization Kinetics", paragraph after equation 23, "where G_0 and K_g are adjustable parameters to be determined by fitting on experimental data"*).

ttt. Regarding **claim 68**:

uuu. Zheng appears to teach:

vvv. predicting material property values at a plurality of locations within a part made from the processed material (*ninth page, figure 3, stresses are determined at multiple locations which are dependent upon determined material properties at the locations*).

www. Regarding **claim 69**:

xxx. Zheng appears to teach:

yyy. predicting material property values of a part having an arbitrary geometry, where the part is made from the processed material (*eighth page, figure 2, a part having arbitrary geometry*).

zzz. Regarding **claim 53**:

aaaa. Zheng appears to teach:

bbbb. (ii) obtain a morphological characterization of the material using the characterization of the flow of the material (*sixth page,*

section "Numerical Method", second paragraph, "The generalized Newtonian kinematics obtained from the solution of the HEle-Shaw equation are then used to calculate the viscoelastic stresses, orientation and crystallinity . . .");

cccc. (iii) predict a value of a property of the material using the morphological characterization (*seventh page, section "Results and Discussion", first paragraph, "The predicted crystallinity can be further used in the viscosity calculation"; viscosity is a property of a material predicted using the morphological characteristic, crystallinity*).

dddd. Zheng does not specifically teach:

eeee. A memory that stores code defining a set of instructions;

ffff. A processor that executes the instructions thereby to:

gggg. (i) obtain a characterization of flow of a material using a process description comprising at least one governing equation;

hhhh. Yu appears to teach:

iiii. A memory that stores code defining a set of instructions (*column 1, lines 65 – 66; "plastic CAE analysis"*);

jjjj. A processor that executes the instructions thereby to (*column 1, lines 65 – 66; "plastic CAE analysis"*);

kkkk. (i) obtain a characterization of flow of a material using a process description comprising at least one governing equation (*column 1, lines 47 – 60; and column 13, lines 12 – 45; this limitation appears to be common knowledge in the art*);

llll. Obviousness must be determined in light of the knowledge of the ordinary artisan. The following references teach knowledge of the ordinary artisan:

i. Antonios K. Doufas et al., "A continuum model for flow-induced crystallization of polymer melts", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004; teaches

simulation of flow-induced crystallization of polymer melts (*Abstract*) using a two phase model with crystallization kinetics (*Abstract, and page 86, last paragraph*), and calculating material properties from morphology (*pages 94 – 95, section C. Calculation of material and rheo-optical properties*).

ii. X. Guo et al., "Crystallinity and Microstructure in Injection Moldings of Isotactic Polypropylenes. Part 1: A New Approach to Modeling and Model Parameters", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42; teaches a simulation of injection molding process of semi-crystalline polymers to predict the development of crystallinity and microstructure (*page 2113, section Conclusions*).

mmmm. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Yu with the art of Zheng to produce the claimed invention.

nnnn. Regarding **claim 54**:

oooo. Zheng appears to teach:

pppp. (c) Providing a two-phase description of the material, wherein the description is based in part on the characterization of the flow of the material (*first page, abstract; an amorphous phase model and a crystalline phase model are used, while the crystallization kinetics model depends upon flow induced stresses*);

qqqq. (d) obtaining a morphological characterization of the material using the two-phase description (*seventh page, section "Results and Discussion", first paragraph, "The introduction of the stress dependent*

nucleation (Eq. (25)) into the crystallization kinetics allows prediction of flow-induced crystallization");

rrrr. (f) predicting a value of a property of the material using the morphological characterization (*seventh page, section "Results and Discussion", first paragraph, "The predicted crystallinity can be further used in the viscosity calculation"; viscosity is a property of a material predicted using the morphological characteristic, crystallinity*).

ssss. Zheng does not specifically teach:

tttt. (a) providing a process description comprising at least one governing equation;

uuuu. (b) obtaining a characterization of a flow of a material using the process description;

vvvv. Yu appears to teach:

wwww. (a) providing a process description comprising at least one governing equation (*column 1, lines 47 - 60; and column 13, lines 12 - 45; this limitation appears to be common knowledge in the art*);

xxxx. (b) obtaining a characterization of a flow of a material using the process description (*column 1, lines 47 - 60; and column 13, lines 12 - 45; this limitation appears to be common knowledge in the art*);

yyyy. Obviousness must be determined in light of the knowledge of the ordinary artisan. The following references teach knowledge of the ordinary artisan:

i. Antonios K. Doufas et al., "A continuum model for flow-induced crystallization of polymer melts", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004; teaches simulation of flow-induced crystallization of polymer melts (*Abstract*) using a two phase model with crystallization kinetics (*Abstract, and page*

86, last paragraph), and calculating material properties from morphology (*pages 94 – 95, section C. Calculation of material and rheo-optical properties*).

ii. X. Guo et al., "Crystallinity and Microstructure in Injection Moldings of Isotactic Polypropylenes. Part 1: A New Approach to Modeling and Model Parameters", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42; teaches a simulation of injection molding process of semi-crystalline polymers to predict the development of crystallinity and microstructure (*page 2113, section Conclusions*).

zzzz. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Yu with the art of Zheng to produce the claimed invention.

aaaaa. Regarding **claim 55**:

bbbbb. Zheng appears to teach:

ccccc. The material undergoes a change of phase during processing (*first page, abstract, crystallization of polymers is a phase change*).

ddddd. Regarding **claim 56**:

eeeee. Zheng appears to teach:

fffff. The two-phase description comprises an amorphous phase model and a semi-crystalline phase model (*first page, abstract, "The amorphous phase is modeled as a Phan-Thien-Tanner fluid . . ."; and third page, last paragraph, section "Semicrystalline phase"*).

12. **Claims 5 and 6** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Bird (R. Byron Bird et al., "Dynamics of Polymeric Liquids", volume 2, second edition, 1987, John Wiley & Sons, pages 362 - 365).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Bird is directed to dynamics of polymeric liquids (Title).

c. The art of Bird and the art of Zheng as modified by Yu are analogous art because they both pertain flow of polymeric liquids.

d. The motivation to use the art of Bird with the art of Zheng as modified by Yu would have been the knowledge of the ordinary artisan that the elastic modulus was a useful property of a material, as described in Bird.

e. Regarding **claim 5**:

f. Zheng does not specifically teach:

g. step (d) comprises predicting an elastic modulus of the material.

h. Bird appears to teach:

i. predicting an elastic modulus of the material (*page 365 and equation 20.3-10*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Bird with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 6**:

l. Zheng does not specifically teach:

m. the elastic modulus is one of the group consisting of a longitudinal Young's modulus, a transverse Young's modulus, an in-plane shear modulus, an out-plane shear modulus, and a plane-strain bulk modulus.

n. Bird appears to teach:

o. the elastic modulus is ~~one of the group consisting of~~ a longitudinal Young's modulus *(page 365 and equation 20.3-10; also please note that it was common knowledge in the art to use the elastic modulus to calculate a bulk modulus)*, ~~a transverse Young's modulus, an in-plane shear modulus, an out-plane shear modulus, and a plane-strain bulk modulus~~.

13. **Claims 7 and 8** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Tanner (Roger I. Tanner, "Engineering Rheology", second edition, 2000, Oxford University Press, pages 60 - 62).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Tanner is directed to engineering rheology (Title).

c. The art of Tanner and the art of Zheng as modified by Yu are analogous art because they both pertain flow of liquids.

d. The motivation to use the art of Tanner with the art of Zheng as modified by Yu would have been the knowledge of the ordinary artisan that the complex modulus was a useful property of a material, as described in Tanner.

e. Regarding **claim** 7:

f. Zheng does not specifically teach:

g. step (d) comprises predicting a complex modulus of the material.

h. Tanner appears to teach:

i. predicting a complex modulus of the material (*page 60, equation 2.88 and surrounding text*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Tanner with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim** 8:

l. Zheng does not specifically teach:

m. (e) predicting a value of a property of the material from the complex modulus.

n. Tanner appears to teach:

o. (e) predicting a value of a property of the material from the complex modulus (*page 60, equation 2:89 and text below, the storage modulus is a property of the material*).

14. **Claims 9 and 11** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Doufas (Antonios K. Doufas et al., "A continuum model for flow-induced crystallization of polymer melts", art provided by

the Applicant on the Information Disclosure Statement dated August 13, 2004, item C26).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Doufas is directed to simulation of flow induced crystallization of polymer melts (Abstract).

c. The art of Doufas and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of calculating viscoelastic flows of polymers.

d. The motivation to use the art of Doufas with the art of Zheng as modified by Yu would have been the benefit recited in Doufas that required computation times are relatively small (*page 107, section VI. Conclusions, second paragraph, last sentence*), which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 9**:

f. Zheng does not specifically teach:

g. step (d) comprises predicting at least one member of the group consisting of a mechanical property, a thermal property, and an optical property.

h. Doufas appears to teach:

i. predicting ~~at least one member of the group consisting of a mechanical property, a thermal property, and~~ an optical property (*page 95, section 2. Birefringence of the semicrystalline system, first sentence*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Doufas with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 11**:

l. Zheng does not specifically teach:

m. step (d) comprises predicting at least one of clarity, opaqueness, surface gloss, color variation, birefringence, and refractive index.

n. Doufas appears to teach:

o. step (d) comprises predicting ~~at least one of clarity, opaqueness, surface gloss, color variation~~, birefringence, ~~and refractive index~~ (*page 95, section 2. Birefringence of the semicrystalline system, first sentence*).

15. **Claim 10** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Hartmann (Bruce Hartmann et al., "Equation of State for Polymer Liquids", 1985, Journal of Applied Polymer Science, volume 30, issue 4, pages 1553 - 1563).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Hartmann is directed to an equation of state for polymer liquids (Title).

c. The art of Hartmann and the art of Zheng as modified by Yu are analogous art because they both pertain to an equation of state for polymers (*Zheng, PVT behavior, sixth page*).

d. The motivation to use the art of Hartmann with the art of Zheng as modified by Yu would have been the benefit recited in Hartmann that required computation times are relatively small (*page 107, section VI. Conclusions, second paragraph, last sentence*), which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 10**:

f. Zheng does not specifically teach:

g. step (d) comprises predicting at least one of a thermal expansion coefficient, a thermal conductivity, a bulk modulus, and a sound speed.

h. Hartmann appears to teach:

i. predicting at least one of a thermal expansion coefficient, ~~a thermal conductivity,~~ a bulk modulus, ~~and a sound speed~~ (*page 1553, Synopsis, last sentence*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Hartmann with the art of Zheng as modified by Yu to produce the claimed invention.

16. **Claims 12 - 13** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Baaijens (F.P.T. Baaijens, "Calculation of residual stresses in injection molded products", 1991, Rheologica Acta, volume 30, pages 284 - 299).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Baaijens is directed to calculation of residual stresses in injection molded products (title).

c. The art of Baaijens and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of calculating properties of molten polymers.

d. The motivation to use the art of Baaijens with the art of Zheng as modified by Yu would have been the benefit recited in Baaijens that the approach considerably reduces computational time (*page 285, right-side column,, first paragraph, last sentence*), which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 12**:

f. Zheng does not specifically teach:

g. predicting at least one component of a stress tensor.

h. Baaijens appears to teach:

i. predicting at least one component of a stress tensor (*page 284, Abstract, first sentence*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Baaijens with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 13**:

l. Zheng does not specifically teach:

m. the stress tensor comprises a measure of flow-induced stress.

n. Baaijens appears to teach:

o. the stress tensor comprises a measure of flow-induced stress (*page 284, Abstract, first sentence*).

17. **Claim 14** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Hulsen (M.A. Hulsen et al., "Simulation of viscoelastic flows using Brownian configuration fields", 1997, Journal of Non-Newtonian Fluid Mechanics, volume 70, pages 79 - 101).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Hulsen is directed to simulation of viscoelastic flows (title).

c. The art of Hulsen and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of calculating viscoelastic flows of polymers.

d. The motivation to use the art of Hulsen with the art of Zheng as modified by Yu would have been the benefit recited in Hulsen that the method is more robust than the conventional macroscopic technique (*page 79, Abstract, last sentence*), which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 14**:

f. Zheng does not specifically teach:

g. the morphological characterization comprises at least one component of a conformation tensor.

h. Azaiez appears to teach:

i. the morphological characterization comprises at least one component of a conformation tensor (*page 84, equation 15; the conformation tensor appears to have been common knowledge in the art*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Hulsen with the art of Zheng as modified by Yu to produce the claimed invention.

18. **Claim 15** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Azaiez (Jalel Azaiez, "Constitutive equations for fiber suspensions in viscoelastic media", 1996, Journal of Non-Newtonian Fluid Mechanics, volume 66, pages 35 - 54).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Azaiez is directed to constitutive equations for fiber suspensions in viscoelastic media (title).

c. The art of Azaiez and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of calculating properties of molten polymers.

d. The motivation to use the art of Azaiez with the art of Zheng as modified by Yu would have been the benefit recited in Azaiez that the model will lead to the best mechanical and thermal properties (*page 35, section I. Introduction, first paragraph, last sentence*), which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 15**:

f. Zheng does not specifically teach:

g. the morphological characterization comprises at least one component of an orientation tensor.

h. Azaiez appears to teach:

i. the morphological characterization comprises at least one component of an orientation tensor (*page 36, section 2. Governing Equations, equation 1; the orientation tensor appears to have been common knowledge in the art*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Azaiez with the art of Zheng as modified by Yu to produce the claimed invention.

19. **Claim 20** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Bushman (A.C. Bushman, "A Continuum Model for the Dynamics of Flow-Induced Crystallization", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C16).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Bushman is directed to a model for flow induced crystallization in polymers (page 2393, section Introduction).

c. The art of Bushman and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of crystallization of polymers.

d. The motivation to use the art of Bushman with the art of Zheng as modified by Yu would have been the benefit recited in Bushman that the model represents the first model of its kind which simultaneously accounts for the dynamics of flow as well as the crystallization occurring, which would have been recognized as a benefit by the ordinary artisan.

e. Regarding **claim 20**:

f. Zheng does not specifically teach:

g. the description of crystallization kinetics of the material comprises a description of flow-induced free energy change.

h. Bushman appears to teach:

i. the description of crystallization kinetics of the material comprises a description of flow-induced free energy change (*pages 2395 - 2399, section Model Development*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Bushman with the art of Zheng as modified by Yu to produce the claimed invention.

20. **Claims 21 and 43 - 44** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Koscher (Koscher et al., "Influence of Shear on polypropylene crystallization: morphology development and kinetics", art provided

by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C54).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Koscher is directed to crystallization morphology and kinetics in polypropylene under shear (*page 6931, Abstract*).

c. The art of Koscher and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of crystallization of polymers.

d. The motivation to use the art of Koscher with the art of Zheng as modified by Yu would have been the benefit recited in Koscher the model developed has the advantage of taking into account the polymer melt rheological behavior through the first normal stress difference equation (*page 6941, section 4. Conclusion*).

e. Regarding **claim 21**:

f. Zheng does not specifically teach:

g. the description of crystallization kinetics of the material comprises a description of flow-induced nucleation.

h. Koscher appears to teach:

i. the description of crystallization kinetics of the material comprises a description of flow-induced nucleation (*pages 6936 - 6937, section 3.3 Kinetic model*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Koscher with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 43**:

l. Zheng does not specifically teach:

m. performing one or more crystallization experiments to determine a half-crystallization time.

n. Koscher appears to teach:

o. performing one or more crystallization experiments to determine a half-crystallization time (*page 6932, sections 2.1 and 2.2; numerous references to half crystallization time determination are in the reference*).

p. Regarding **claim 44**:

q. Zheng does not specifically teach:

r. performing one or more experiments to determine at least one of a relaxation spectrum and a time-temperature shift factor.

s. Koscher appears to teach:

t. performing one or more experiments to determine at least one of a relaxation spectrum and a time-temperature shift factor (*page 6933, section 2.3 Rheological experiments, first sentence, and section 2.3.1 Frequency sweep experiments*).

21. **Claim 26** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Purnode (B. Purnode et al., "Polymer solution characterization with the FENE-P model", 1998, Journal of Non-Newtonian Fluid Mechanics, Volume 77, pages 1 - 20).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Purnode is directed to the FENE-P constitutive model for describing rheological properties of a polymer solution (*page 1, abstract*).

c. The art of Purnode and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of flowing polymers.

d. The motivation to use the art of Purnode with the art of Zheng as modified by Yu would have been the benefit recited in Purnode that the FENE-P model is highly suitable for polymer solutions (*page 2, fourth paragraph that starts with, "In this paper . . .", first sentence*).

e. Regarding **claim 26**:

f. Zheng does not specifically teach:

g. the viscoelastic constitutive equation comprises a FENE-P dumbbell model.

h. Purnode appears to teach:

i. the viscoelastic constitutive equation comprises a FENE-P dumbbell model (*page 2, fourth paragraph that starts with, "In this paper . . .", first sentence, and pages 5 - 9, section 3; the FENE-P model appears to be common knowledge in the art, for example in Bird, Dynamics of Polymeric Liquids*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Purnode with the art of Zheng as modified by Yu to produce the claimed invention.

22. **Claim 27** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Verbeeten (Wilco M. H. Verbeeten et al., "Viscoelastic analysis of complex polymer melt flows using the eXtended pom-pom model", December 2002, Journal of Non-Newtonian Fluid Mechanics, Volume 108, Issues 1 – 3, pages 301 - 326).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Verbeeten is directed to viscoelastic analysis of complex polymer melt flows using the eXtended pom-pom model (*page 301, title and abstract*).

c. The art of Verbeeten and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of flowing molten polymers.

d. The motivation to use the art of Verbeeten with the art of Zheng as modified by Yu would have been the benefit recited in Verbeeten that the model shows the best overall description of the available rheometrical data (*page 321, section 6. Conclusions, second paragraph, first sentence*).

e. Regarding **claim 27**:

f. Zheng does not specifically teach:

g. the viscoelastic constitutive equation comprises at least one of an extended POM-POM model and a POM-POM model.

h. Verbeeten appears to teach:

i. the viscoelastic constitutive equation comprises at least one of an extended POM-POM model and a POM-POM model (*page 304, third paragraph that starts with, "A new class of constitutive relations . . ."*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Verbeeten with the art of Zheng as modified by Yu to produce the claimed invention.

23. **Claim 37** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of YuHybrid (Yu et al., "A Hybrid 3D/2D Finite Element Technique for Polymer Processing Operations", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C92).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of YuHybrid is directed to a hybrid 3D/2D finite element technique for polymer processing operations (*title and abstract*).

c. The art of YuHybrid and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of flowing molten polymers.

d. The motivation to use the art of YuHybrid with the art of Zheng as modified by Yu would have been the knowledge of the ordinary artisan that a hybrid solution method would reduce computational processing time (*Abstract*).

e. Regarding **claim 37**:

f. Zheng does not specifically teach:

g. obtaining the flow characterization comprises using a hybrid solution method.

h. YuHybrid appears to teach:

i. obtaining the flow characterization comprises using a hybrid solution method (*Abstract*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of YuHybrid with the art of Zheng as modified by Yu to produce the claimed invention.

24. **Claims 3, 42, 70** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Guo (X. Guo et al., "Crystallinity and Microstructure in Injection Moldings of Isotactic Polypropylenes. Part 1: A New Approach to Modeling and Model Parameters", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Guo is directed to a simulation of injection molding process of semi-crystalline polymers to predict the development of crystallinity and microstructure (*page 2113, section Conclusions*).

c. The art of Guo and the art of Zheng as modified by Yu are analogous art because they both pertain to the art of crystallization of polymers.

d. The motivation to use the art of Guo with the art of Zheng as modified by Yu would have been the knowledge of the ordinary artisan that an accurate simulation of the injection molding process can cut down on the expensive costs of tooling and trial-and-error mold testing (*page 2097, left-side column, lines 1 – 5*).

e. Regarding **claim 42**:

f. Zheng does not specifically teach:

g. performing one or more crystallization experiments to determine a crystal growth rate of the material under quiescent conditions.

h. Guo appears to teach:

i. performing one or more crystallization experiments to determine a crystal growth rate of the material under quiescent conditions (*pages 2104 - 2105, section Quiescent Crystallization*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Guo with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 3**:

l. Zheng does not specifically teach:

m. wherein the process description comprises a representation of at least one member of the group consisting of an extrusion process, a blow molding process, a vacuum forming process, a spinning process, and a curing process.

n. Guo appears to teach:

o. the process description comprises a representation of an extrusion process (*page 2105, section "Flow-Induced Crystallization", first paragraph; all of the processes appear to be common knowledge*).

p. Regarding **claim 70**:

q. Zheng does not specifically teach:

r. the process description comprises a representation of at least one member of the group consisting of a profile extrusion process, a blow film extrusion process, and a film extrusion process.

s. Guo appears to teach:

t. a profile extrusion process (*page 2105, section "Flow-Induced Crystallization", first paragraph; all of the processes appear to be common knowledge*).

25. **Claims 30 - 33** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Kennedy (R. Zheng, P. Kennedy, N. Phan-Thien, X-J. Fan; "Thermoviscoelastic simulation of thermally and pressure-induced stresses in injection moulding for the prediction of shrinkage and warpage for fibre-reinforced thermoplastics", 1999, Journal Non-Newtonian Fluid Mechanics, pages 159 – 190).

a. Zheng as modified by Yu teaches a method of predicting a value of a property of processed material, as recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Zheng as modified by Yu and the art of Kennedy are analogous art because they both pertain to the art of injection molded plastic articles.

c. The motivation to use the art of Kennedy with the art of Zheng as modified by Yu would have been the knowledge of the ordinary artisan that predicting shrinkage and warpage in finished products is a benefit (*page 159, Abstract, "The computed residual stresses enable us to predict shrinkage and warpage in the finished products"*). Further, Kennedy appears to be a co-author of the Zheng reference.

d. Regarding **claim 30**:

e. Zheng does not specifically teach:

f. (e) performing a structural analysis of a product made from the processed material using the value of the property of the material.

g. Kennedy appears to teach:

h. performing a structural analysis of a product made from the processed material using the value of the property of the material. (*page 175, section 3.4 Structural analysis; and pages 181 - 183, section 4.3 and figure 10*).

i. Obviousness must be determined in light of the knowledge of the ordinary artisan. The following references teach knowledge of the ordinary artisan:

i. Z. Fan, R. Zheng, P. Kennedy, "Warpage Analysis of Solid Geometry", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C35; teaches structural analysis and warpage analysis using finite element method.

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Kennedy with the art of Zheng as modified by Yu to produce the claimed invention.

k. Regarding **claim 31**:

l. Zheng does not specifically teach:

m. (e) comprises predicting warpage of the product.

n. Kennedy appears to teach:

o. (e) comprises predicting warpage of the product (*page 181, section 4.3, first sentence*).

p. Regarding **claim 32**:

q. Zheng does not specifically teach:

r. `(e) comprises predicting shrinkage of the product.`

s. Kennedy appears to teach:

t. (e) comprises predicting shrinkage of the product (*page 159, title and abstract*).

u. Regarding **claim 33**:

v. Zheng does not specifically teach:

w. `(e) comprises predicting how the product reacts to a force.`

x. Kennedy appears to teach:

y. (e) comprises predicting how the product reacts to a force (*page 175, section 3.4 Structural analysis, second paragraph, first sentence, "The calculated thermally and pressure induced stresses serve as the initial stresses to form the load term . . ."; a load term is a force. This limitation appears to be common knowledge*).

26. **Claim 34** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu and Kennedy as applied to claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above, further in view of Takahara (U.S. Patent Number 6,581,473).

a. Zheng as modified by Yu and Kennedy teaches a method of predicting a value of a property of processed material and performing a structural analysis, as

recited in claims 1 - 2, 4, 16 - 19, 22 - 25, 28 - 29, 36, 38 - 41, 53 - 56 and 68 - 69 above.

b. The art of Takahara is directed to analyzing the creep of a plastic molded object (*Abstract*).

c. The art of Zheng as modified by Yu and Kennedy and the art of Takahara are analogous art because they both pertain to the art of molded plastic.

d. The motivation to use the art of Takahara with the art of Zheng as modified by Yu and Kennedy would have been the benefit recited in Takahara that the analysis precision of the creep characteristic can be improved (*column 4, lines 18 - 21*).

e. Regarding **claim 34**:

f. Zheng does not specifically teach:

g. (e) predicting at least one of the group consisting of crack propagation, creep, and wear.

h. Takahara appears to teach:

i. (e) predicting creep (*column 1, lines 43 - 65*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Takahara with the art of Zheng as modified by Yu and Kennedy to produce the claimed invention.

27. **Claim 35** is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng as modified by Yu, Kennedy and Takahara as applied to claim 34 above, further in view of Seale (U.S. Patent Application Publication 2002/0157478).

a. Zheng as modified by Yu, Kennedy and Takahara teaches a method of predicting a value of a property of processed material and performing a structural analysis, as recited in claim 34 above.

b. The art of Seale is directed to characterizing material properties including polymers (*Abstract*).

c. The art of Zheng as modified by Yu, Kennedy and Takahara and the art of Seale are analogous art because they both pertain to determining polymer properties.

d. The motivation to use the art of Seale with the art of Zheng as modified by Yu and Kennedy and Takahara would have been the benefit recited in Seale that the methods may require far fewer simulation runs in order to converge (*paragraph [0149], last sentence*).

e. Regarding **claim 35**:

f. Zheng does not specifically teach:

g. e) comprises predicting at least one member of the group consisting of impact strength, mode of failure, mode of ductile failure, mode of brittle failure, failure stress, failure strain, failure modulus, failure flexural modulus, failure tensile modulus, stiffness, maximum loading, and burst strength.

h. Seale appears to teach:

i. (e) predicting failure stress (*paragraph [0143], sentences 1 - 5*).

j. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Seale with the art of Zheng as modified by Yu and Kennedy and Takahara to produce the claimed invention.

28. **Claims 45 - 49 and 71** are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng (R. Zheng and P. Kennedy, "Numerical Simulation of Crystallization in Injection Molding", art provided by the Applicant on the Information Disclosure Statement dated January 31, 2005, item number C118) in view of Yu (U.S. Patent Number 6,096,088), further in view of Kennedy (R. Zheng, P. Kennedy, N. Phan-Thien, X-J. Fan; "Thermoviscoelastic simulation of thermally and pressure-induced stresses in injection moulding for the prediction of shrinkage and warpage for fibre-reinforced thermoplastics", 1999, Journal Non-Newtonian Fluid Mechanics, pages 159 – 190).

a. The art of Yu is directed to design of articles to be manufactured by injection molding, preferably from molten plastic materials (*column 1, lines 5 – 10*).

b. The art of Zheng is directed to numerical simulation of crystallization in injection molding of polymers (*title, abstract*).

c. The art of Kennedy is directed to simulation of stresses in injection molded plastic products (*page 159, Abstract*).

d. The art of Zheng and the art of Yu are analogous art at least because they both pertain to injection molding of plastic articles.

e. The art of Zheng and the art of Kennedy are analogous art because they both pertain to the art of injection molded plastic articles.

f. The motivation to use the art of Yu with the art of Zheng would have been the benefit recited in Yu that economic benefit is derived from simulation

because problems can be predicted and solutions tested prior to the actual creation of a mold (*column 1, lines 25 – 30*).

g. The motivation to use the art of Kennedy with the art of Zheng would have been the knowledge of the ordinary artisan that predicting shrinkage and warpage in finished products is a benefit (*page 159, Abstract, "The computed residual stresses enable us to predict shrinkage and warpage in the finished products"*). Further, Kennedy appears to be a co-author of the Zheng reference.

h. Regarding **claim 45**:

i. Zheng appears to teach:

j. (c) obtaining a morphological characterization of the material using the characterization of the flow of the material (*sixth page, section "Numerical Method", second paragraph, "The generalized Newtonian kinematics obtained from the solution of the HEle-Shaw equation are then used to calculate the viscoelastic stresses, orientation and crystallinity . . ."*);

k. (d) predicting a value of a property of the material using the morphological characterization (*seventh page, section "Results and Discussion", first paragraph, "The predicted crystallinity can be further used in the viscosity calculation"; viscosity is a property of a material predicted using the morphological characteristic, crystallinity*).

l. Zheng does not specifically teach:

m. (a) providing a process description comprising at least one governing equation;

n. (b) obtaining a characterization of a flow of a material using the process description;

o. (e) performing a structural analysis of a part made from the material using the predicted value of the property.

p. Yu appears to teach:

q. (a) providing a process description comprising at least one governing equation (*column 1, lines 47 - 60; and column 13, lines 12 - 45; this limitation appears to be common knowledge in the art*);

r. (b) obtaining a characterization of a flow of a material using the process description (*column 1, lines 47 - 60; and column 13, lines 12 - 45; this limitation appears to be common knowledge in the art*);

s. Kennedy appears to teach:

t. (e) performing a structural analysis of a part made from the material using a predicted value of a property (*page 175, section 3.4 Structural analysis; and pages 181 - 183, section 4.3 and figure 10*).

u. Obviousness must be determined in light of the knowledge of the ordinary artisan. The following references teach knowledge of the ordinary artisan:

i. Z. Fan, R. Zheng, P. Kennedy, "Warpage Analysis of Solid Geometry", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C35; teaches structural analysis and warpage analysis using finite element method.

ii. Antonios K. Doufas et al., "A continuum model for flow-induced crystallization of polymer melts", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004; teaches simulation of flow-induced crystallization of polymer melts (*Abstract*) using a two phase model with crystallization kinetics (*Abstract, and page 86, last paragraph*), and calculating material properties from morphology (*pages 94 – 95, section C. Calculation of material and rheo-optical properties*).

iii. X. Guo et al., "Crystallinity and Microstructure in Injection Moldings of Isotactic Polypropylenes. Part 1: A New Approach to Modeling and Model Parameters", art provided by the Applicant on the Information Disclosure Statement dated August 13, 2004, item C42; teaches a simulation of injection molding process of semi-crystalline polymers to predict the development of crystallinity and microstructure (*page 2113, section Conclusions*).

v. Therefore, as discussed above, it would have been obvious to the ordinary artisan at the time of invention to use the art of Yu and the art of Kennedy with the art of Zheng to produce the claimed invention.

w. Regarding **claim 46**:

x. Zheng does not specifically teach:

y. wherein step (e) comprises creating a structural analysis constitutive model.

z. Kennedy appears to teach:

aa. creating a structural analysis constitutive model (*page 166, equation (10), Hooke's law is a structural analysis constitutive model*).

bb. Regarding **claim 47**:

cc. Zheng does not specifically teach:

dd. wherein step (e) comprises predicting a response of the part to a load.

ee. Kennedy appears to teach:

ff. wherein step (e) comprises predicting a response of the part to a load (*page 175, section 3.4 Structural analysis, second paragraph, first sentence, "the load term", and second sentence, "Once the load and boundary conditions are applied, . . ."*).

gg. Regarding **claim 48**:

hh. Zheng does not specifically teach:

ii. wherein step (e) comprises predicting warpage of the part.

jj. Kennedy appears to teach:

kk. predicting warpage of the part (*page 181, section 4.3, first sentence*).

ll. Regarding **claim 49**:

mm. Zheng does not specifically teach:

nn. wherein step (e) comprises predicting at least one member of the group consisting of warpage, shrinkage, crack propagation, creep, wear, lifetime, and failure.

oo. Kennedy appears to teach:

pp. predicting warpage (*page 181, section 4.3, first sentence*).

qq. Regarding **claim 71**:

rr. Zheng does not specifically teach:

ss. wherein step (e) comprises predicting a response of the part to a thermal load.

tt. Kennedy appears to teach:

uu.wherein step (e) comprises predicting a response of the part to a thermal load (*page 175, section 3.4 Structural analysis, second paragraph, first sentence, "The calculated thermally . . . induced stresses serve as the initial stresses to form the load term . . ."*).

29. **Examiner's Note:** Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the Applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the Examiner. The entire reference is considered to provide disclosure relating to the claimed invention.

Conclusion

30. While not prior art, the following document appears to be relevant:

a. R. Zheng and P.K. Kennedy, "A model for post-flow induced crystallization: General equations and predictions", art provided by the Applicant on the Information Disclosure Statement dated November 16, 2004, item C105; appears to describe further rationale supporting the invention, *especially page 825, paragraph after equation 2, and page 826, paragraph after equation 8, and page 840, section IV. Conclusions.*

31. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Russ Guill whose telephone number is 571-272-7955. The examiner can normally be reached on Monday - Friday 9:30 AM - 6:00 PM.

32. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached on 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Any inquiry of a general nature or relating to the status of this application should be directed to the TC2100 Group Receptionist: 571-272-2100.

33. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Russ Guill
Examiner
Art Unit 2123

RG

PAUL RODRIGUEZ
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100